DOCUMENT RESUME

ED 076 048 EM 011 050

AUTHOR	Igo, Robert; And Others
TITLE	Commonwealth CAI Consortium, E.S.E.A., Title III.
INSTITUTION	Pennsylvania State Univ., University Park. Computer-Assisted Instruction Lab.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
REPORT NO	PSU-CAI-R-41
PUB DATE	28 Feb 71
GRANT	OEG-0-8-055230-3479
NOTE	13p.; See Also ED 059 604
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Algebra; *Computer Assisted Instruction; *Curriculum Development; *Grade 9; Individualized Instruction; Mathematics Education; *Mathematics Instruction; Performance; Technical Reports
IDENTIFIERS	Elementary Secondary Education Act Title III

ABSTRACT

Algebra I and General Mathematics courses using tutorial instructional programs under computer control supplemented by "off-line" materials (included in the computer controlled testing) have been developed for a ninth grade student population. The relationships of instructional materials, pretests, posttests, and choice points are illustrated by flow charts for a chapter and are an instructional unit within a chapter. The personnel, facilities, and procedures for course correction and revision are briefly summarized, and tables provide a description of the completeness of the courses, the evaluation plans, and a few very preliminary findings. (EM 011 037 through EM 011 043, EM 011 046, EM 011 047, and EM 011 049 through EM 011 058 are related documents. The preliminary report of the previous year, 1970, can be found as EM 011 046.) (RH)

FORM 510

PRINTED IN U.S.A.

ED 076048 R41

Commonwealth CAI Consortium
ESEA Title III Project No. 5523
Technical Report, February 28, 1971
R - 41

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

Prepared by Robert Igo, K. A. Hall, and H. E. Mitzel
Computer Assisted Instruction Laboratory
The Pennsylvania State University

Course Development

The Algebra I and General Mathematics course have been developed for a ninth grade student population. The essential innovative feature of these courses is a tutorial instructional program under computer control. The "on-line" program is supplemented by a variety of more conventional individualized learning experiences.

The pupils receive basic instruction in mathematical concepts from the computer-assisted instruction (CAI) program. A record of the pupil's interaction with the CAI program is stored in the computer. These performance data serve to direct the flow of the "on-line" instruction. The pupil whose performance indicates rapid acquisition of the mathematical concepts, by-passes the detailed instruction required to bring a less able student to criterion.

The course material in the CAI program has been organized into chapters similar to the chapters in a textbook. The chapters have been subdivided into instructional blocks. The attached flowcharts (Appendix A) illustrate the structure of a chapter and an instructional block within a chapter.

A preskills test will test the prerequisite skills taught in prior chapters of the current course and the more sophisticated concepts introduced in previous mathematics courses. They will not test for the basic arithmetic operations that all pupils should have acquired by this point in their schooling. Experience has shown that some pupils will be deficient in these skills. It will be the teachers' responsibility to identify these pupils. On-line drill programs in the basic operations are available for the practice necessary to develop proficiency with the basic arithmetic operational skills.

EM 011 050

As indicated in Flowchart I, remedial instruction will be provided in the area indicated by inadequate performance on the preskills tests. The remedial instruction will be provided on-line if the appropriate instruction exists; otherwise, off-line material will be available to provide remediation.

Flowchart II illustrates the structure and program flow for an instructional block. The number of concepts presented in an instructional block was determined from an analysis of the student records obtained from the Lincoln and Schenley CAI classes during the 1969-70 school year.

The essential features of an instructional block are the pretests, instruction, practice, summary, criterion quiz, and an option to return to a previous instructional sequence within a block if criterion on that block was not attained. A pupil has an option to take a pretest or to go directly to instruction. If a pretest is taken and criterion is met, the program skips to the next instructional block.

When a summary is completed, the pupil is referred to off-line material that will provide additional practice on the concepts presented in the instruction. When the pupil has completed the off-line assignment and returns to the on-line program, a criterion quiz will be administered. If criterion is met, the program proceeds to the next instructional block. If criterion is not met, an option to repeat all or part of the material previously presented in that instructional block is available. A second failure of the criterion quiz will result in an additional off-line assignment being given by the program. If criterion is not met on the third iteration of the quiz, the program proceeds to the next instructional block.

A major effort has been made to provide off-line materials in addition to the practice materials presented in the regular assignments. The additional material is designed to supplement the basic instruction by introducing topics not presented on line. These materials include filmstrips, mathematical games, programed instruction materials, printed materials, and manipulative materials.

Tests have been developed for on-line administration at the end of each chapter of the algebra and general mathematics courses. The test items parallel the format and the content of questions presented in the instructional program.

The chapter tests should be viewed as criterion tests for the chapters. If a pupil's performance is unsatisfactory, the areas of difficulty may be identified by the teacher and remedial activities prescribed.

A mid-course test is administered on line at the end of Chapter Five in General Mathematics and at the end of Chapter Four in Algebra. The items of the mid-course tests parallel items presented in the previous chapter tests.

Course Correction and Revision

The major effort of the Penn State staff is directed to revising the structure of the existing instructional program to conform to the format presented in the flowcharts. Preskills tests, pretests, criterion quizzes, and summaries did not exist as unique features in the original version of the program. These items must be written and incorporated in the computer program.

Computer programs are being written to accommodate the instructional material that has not been previously programed. Extensive revisions to the content of Chapters Five and Seven in Algebra and Chapters Five, Eight, and Nine in General Mathematics are being made.

Personnel

Professor Lars Jansson, mathematics educator in the College of Education, has assumed the responsibility for the content of the instructional materials. He is assisted by Consortium staff members who have had experience teaching high school mathematics.

Facilities

An IBM 1500 system with thirty 1510 instructional stations with typewriter keyboard and light pens and thirty image projectors is operating at Lincoln and Schenley High Schools. The Consortium staff continued to use approximately 45 per cent of Penn State's CAI system during the present report period.

Schedule

The schedule for revising the course material is provided in Appendix B.

Evaluation

An evaluation of the CAI algebra and general mathematics courses at Lincoln and Schenley High Schools began in September, 1970. The variables to be measured are mathematics achievement, attitude toward mathematics and attitude toward CAI. Two tests will be used to measure achievement in mathematics--The Cooperative Mathematics Test, Algebra I, and the Stanford Achievement Test, Form X. Non-standardized tests which contain items that parallel items presented in the CAI courses chapter tests, were developed for algebra and general mathematics. Attitude toward mathematics is measured by the Attitude Toward Mathematics test developed by Professors Marilyn N. Suydam and Cecil Trueblood of the Penn State College of Education faculty. An instrument to measure attitude toward CAI was also developed by Professor Suydam.

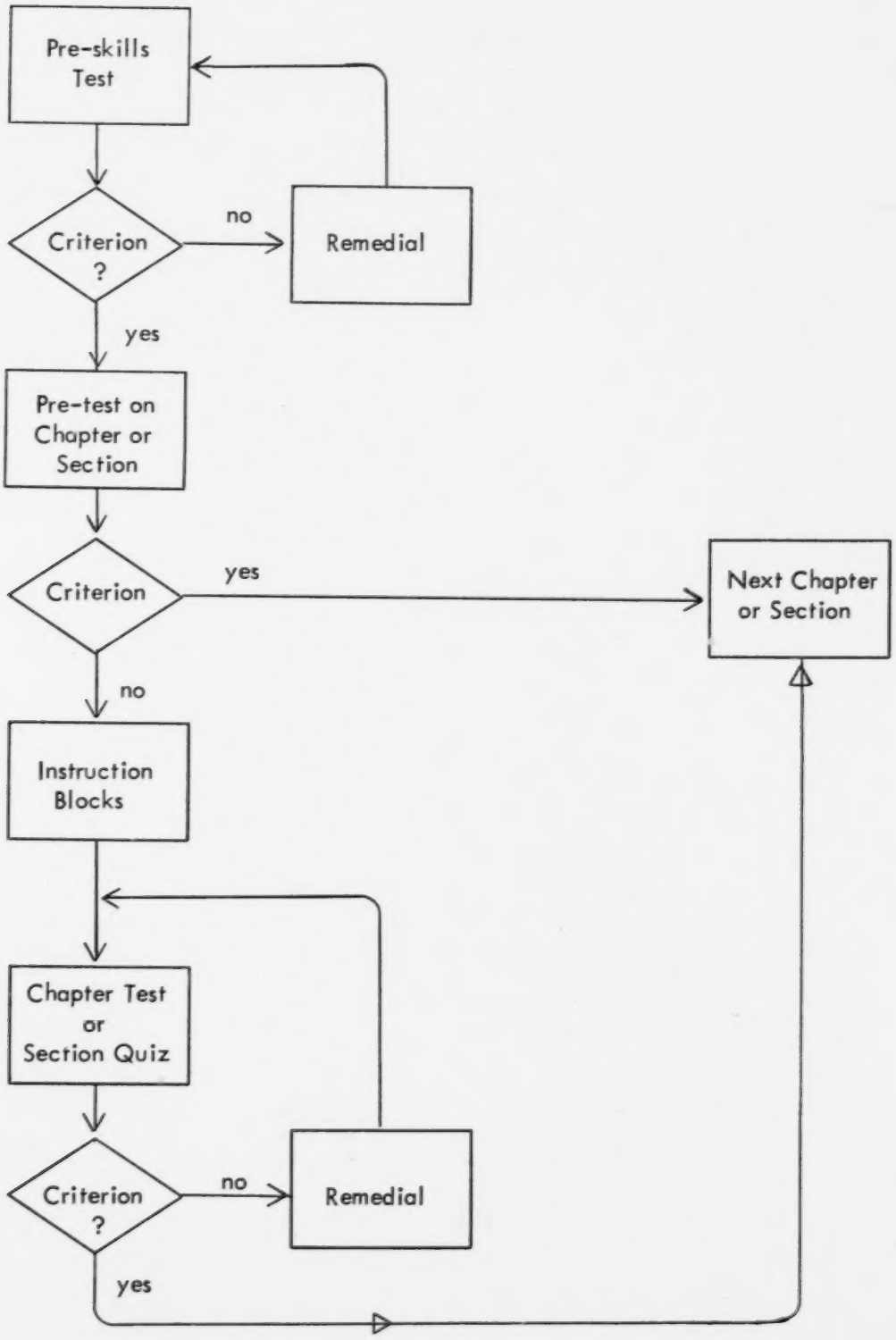
The achievement and attitude toward mathematics of the pupils in the CAI courses is to be compared with the achievement in cohort groups receiving conventional instruction in Algebra I and General Mathematics. The cohort groups in Philadelphia were obtained from conventional classes at Lincoln High School. Since all of the students enrolled in Algebra I and General Mathematics at Schenley received instruction in CAI classes, cohort groups were obtained from conventional classes in Peabody High School, Pittsburgh. The student population at Peabody is assumed to be comparable to the student population at Schenley.

The status of the evaluation and a tentative schedule for the administration of posttests is provided in Appendix C.

Appendix A

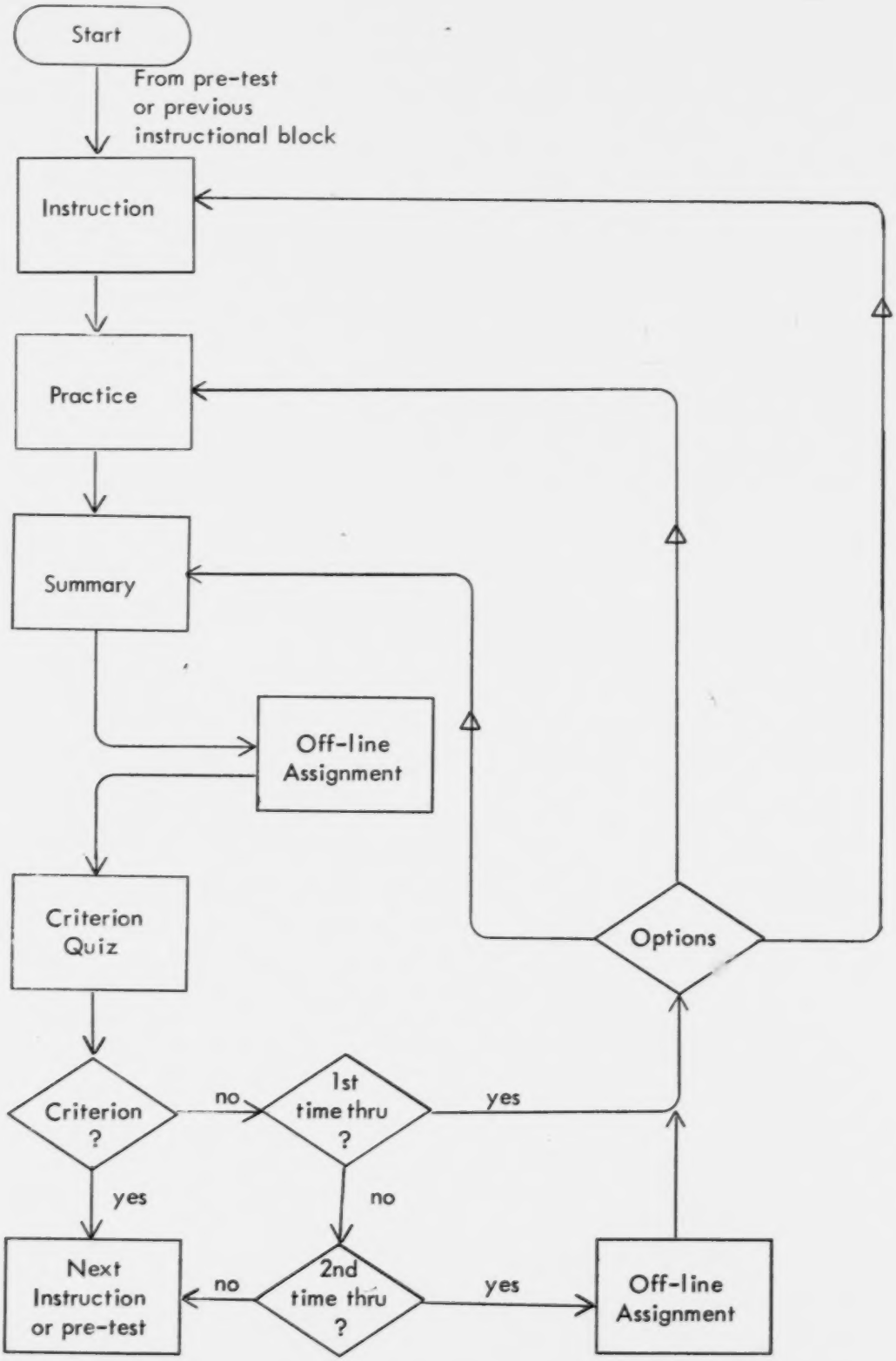
FLOWCHART I

Chapter or Section of a Chapter



FLOWCHART II

Instructional Block



Commonwealth CAI Consortium

Curriculum Revision Plans -- July 1, 1970 - June 15, 1971

Algebra

Chapter	Instructional Components							Completed For Field Use	Projected Completion Date
	Preskills Test	Pretest	Instruction	Practice	Summary	Criterion Test	Assignment		
1	100%	100%	100%	100%	100%	100%	100%	100%	August, 1970
2	N.A.*	100%	100%	100%	100%	100%	100%	100%	August, 1970
3	100%	100%	100%	100%	100%	100%	100%	100%	October, 1970
4	100%	100%	100%	100%	100%	100%	100%	100%	November, 1970
5	100%	100%	100%	100%	100%	100%	100%	100%	January, 1971
6	100%	100%	100%	100%	100%	100%	100%	75%	February, 1971
7	50%	50%	100%	100%	50%	50%	25%	50%	March, 1971
8	50%	50%	100%	100%	50%	50%	25%	50%	April, 1971
9			75%	75%					May, 1971

N.B. Percents indicate the amount of work completed February 28, 1971.

* Not Applicable

Chapters:

1 Numbers and Set Notation
2 Properties of Operations
3 Integers, Properties and Operations
4 Operations with Rational Numbers and Real Numbers
5 Equations, Inequalities and Problem Solving
6 Linear Systems
7 Polynomials
8 Rational Expressions
9 Irrational Numbers and Radicals

Appendix B

FILMED FROM BEST AVAILABLE COPY

Commonwealth CAI Consortium

Curriculum Revision Plans -- July 1, 1970 - June 15, 1971

General Mathematics

Chapter	Instructional Components							Completed For Field Use	Projected Completion Date
	Preskills Test	Pretest	Instruction	Practice	Summary	Criterion Test	Assignment		
1	100%	100%	100%	100%	100%	100%	100%	100%	August, 1970
2	N.A.*	100%	100%	100%	100%	100%	100%	100%	August, 1970
3	N.A.*	100%	100%	100%	100%	100%	100%	100%	August, 1970
4	100%	100%	100%	100%	100%	100%	100%	100%	September, 1970
5	100%	100%	100%	100%	100%	100%	100%	100%	October, 1970
6	100%	100%	100%	100%	100%	100%	100%	100%	October, 1970
7	N.A.*	100%	100%	100%	100%	100%	100%	100%	November, 1970
8	N.A.*	100%	100%	100%	100%	100%	100%	100%	December, 1970
9 **	N.A.*	50%	100%	100%	50%	50%	50%	50%	March, 1971
10 **	N.A.*		50%	50%					April, 1971
11	N.A.*	25%	100%	100%	25%	25%	25%	10%	April, 1971

N.B. Percents indicate the amount of work completed February 28, 1971.

* Not Applicable

** Instruction and Practice to be revised.

Chapters:

1 Equations
2 Negative Integers
3 Division of Whole Numbers
4 Decimals
5 Rational Fractions
6 Ratio and Proportion
7 Percent
8 Problem Solving-Formulas
9 Geometry
10 Measurement
11 Graphing

Appendix C

Consortium Evaluation
Status as of February 28, 1971

1. Data from the achievement pretests on both non-standardized and standardized tests.

School	Course	Group	Test*	n	$\overline{X}$	r
Schenley	Genma	CAI	non-stan.	131	14.33	.73
Peabody	Genma	cohort	non-stan.	82	14.67	.69
Schenley	Genma	CAI	stan.	131	13.99	.87
Peabody	Genma	cohort	stan.	88	12.48	.76
Lincoln	Genma	CAI	non-stan.	220	15.20	.59
Lincoln	Genma	cohort	non-stan.	69	15.10	.75
Lincoln	Genma	CAI	stan.	218	14.25	.67
Lincoln	Genma	cohort	stan.	68	13.63	.70
Schenley	Algeb	CAI	non-stan.	247	9.30	.30
Peabody	Algeb	cohort	non-stan.	93	12.27	.62
Schenley	Algeb	CAI	stan.	249	8.64	.35
Peabody	Algeb	cohort	stan.	97	11.33	.58
Lincoln	Algeb	CAI	non-stan.	219	10.77	.45
Lincoln	Algeb	cohort	non-stan.	104	9.95	.48
Lincoln	Algeb	CAI	stan.	221	10.66	.57
Lincoln	Algeb	cohort	stan.	100	10.35	.55

* Genma non-standardized test has 33 items
Genma standardized test has 45 items

Algeb non-standardized test has 32 items
Algeb standardized test has 40 items

2. Data from the second administration of the Attitude Toward Mathematics scale in Philadelphia.

School	Course	Group	n	$\overline{X}$	low attitude $\overline{X}$	high attitude $\overline{X}$	r
Lincoln	Genma	CAI	201	79.55	61.86	97.20	.92
Lincoln	Genma	cohort	77	76.88	55.82	96.62	.93
Lincoln	Algeb	CAI	201	87.13	67.98	105.23	.94
Lincoln	Algeb	cohort	71	78.32	59.05	97.00	.93

3. Data from the second administration of the Attitude Toward Computer Assisted Instruction scale in Philadelphia.

School	Course	Group	n	$\overline{X}$	low attitude $\overline{X}$	high attitude $\overline{X}$	r
Lincoln	Genma	CAI	201	86.54	71.72	101.19	.86
Lincoln	Algeb	CAI	201	90.06	74.38	104.03	.90

4. While no statistical analyses of the attitude scale data from Philadelphia have been done, inspection indicates that there was:

on the mathematics scale

a slight increase in the CAI genma mean (from 76.38 to 79.55)
a minimal change in the cohort genma mean (from 76.55 to 76.88)
a minimal change in the CAI algeb mean (from 87.74 to 87.13)
a slight decrease in the cohort algeb mean (from 84.53 to 78.32)

on the CAI scale

a slight decrease in the CAI genma mean (from 89.77 to 86.54)
a slight decrease in the CAI algeb mean (from 92.13 to 90.06)

I. A tentative schedule for administration of posttests has been determined:

test or scale	course	groups	administration date: Pittsburgh	administration date: Philadelphia
Attitude Toward CAI	genma and algeb	CAI only	as students on CAI complete the program, or during the week of May 31	as students on CAI complete the program, or during the week of June 14
Attitude Toward Mathematics	gen. math and algebra	CAI and cohort	June 7	June 21
Attitude Toward Instructional Setting	gen. math and algebra	CAI and cohort	June 7	June 21
Stanford Achievement Test, Form W	gen. math	CAI and cohort	June 8	June 22
Non-standardized posttest, Parts A and B	gen. math	CAI and cohort	June 9	June 23
Cooperative Algebra Test, Form 1-B	algebra	CAI and cohort	June 8	June 22
Non-standardized posttest	algebra	CAI and cohort	June 9	June 23

It should be noted that the tests are scheduled to be given in Philadelphia after the ending date of the project. It would seem impossible to analyze data and prepare a final report before the end of July at the earliest.

II. In analyzing the data, we plan to attempt answers to questions such as:

1. Questions to be answered:

   a. Is there a difference between groups following CAI or non-CAI instruction?

      (1) achievement

(a) Pittsburgh genma
(b) Pittsburgh algeb
(c) Philadelphia genma
(d) Philadelphia algeb

(2) attitude

(a) Pittsburgh genma
(b) Pittsburgh algeb
(c) Philadelphia genma
(d) Philadelphia algeb

b. Is CAI more effective for those of low or high ability?

c. Is CAI more effective for those with low or high achievement?

d. Is achievement/attitude related to previous achievement?

e. Is achievement/attitude related to attendance? (for each student, independent of time on-line)

f. Is achievement/attitude related to number of years in school?

g. Is achievement/attitude related to time on-line? (How fast could they have finished?)

2. Data to be collected

a. Achievement

(1) Standardized test: pre, post (per group)

(2) Non-standardized test: pre, post (per group)

b. Attitude

(1) Toward mathematics: pre, mid?, post (per group)

(2) Toward CAI: pre, mid, post (per CAI group)

(3) Toward setting: post (per group)

c. Intelligence (IQ; ability)(per group)
d. Previous achievement (per group)
e. Attendance (per group)
f. Years in school (per group)

--- from school records

g. Time on-line (per CAI group)

3. Statistical analysis

   a. Correlational matrix with gain scores (COV; multiple regression; multivariate analysis; QSASE)

   b. Identify covariates

   c. AOV on scores adjusted for multiple covariates

4. Guidelines

   a. No analyses between Pittsburgh and Philadelphia

   b. Gain scores; repeated measures; provide range-distribution of scores

   c. Supplement with classroom descriptions; discuss why students not independent; graphs; "dramatic cases"

   d. Use data only from those taking all tests (identify why n is decreased)

Note to accompany the Penn State Documents.

In order to have the entire collection of reports generated by the Computer Assisted Instruction Lab. at Penn State University included in the ERIC archives, the ERIC Clearinghouse on Educational Media and Technology was asked by Penn State to input the material. We are therefore including some documents which may be several years old. Also, so that our bibliographic information will conform with Penn State's, we have occasionally changed the title somewhat, or added information that may not be on the title page. Two of the documents in the CARE (Computer Assisted Remedial Education) collection were transferred to ERIC/EC to abstract. They are Report Number R-36 and Report Number R-50.

— Joe McDonald: /ERIC/EM